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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003906092 for a patent by SCALZO AUTOMOTIVE RESEARCH P/L as filed on 05 November 2003.

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VARIABLE STROKE PISTON ENGINE.

This invention relates to variable displacement or stroke, internal combustion engines and more particularly to an arrangement having efficient power-transmitting for stroke varying mechanism whereby the displacement of the pistons is varied by the piston stroke. These types of stroke varying mechanisms are known to contribute substantial fuel economy improvements during part load operation.

Conventional internal combustion engines (ICE) are generally configured in an in-line, horizontally opposed or in a V formation. In a vehicle installation they are sized in volumetric capacity to achieve the desired maximum speed and acceleration requirements. This engine size generally means that at low load conditions, deceleration and braking periods, which is majority of the time, the fuel consumption is high because the engine needs to be throttled and operate at a much lower overall efficiency.

It is the object of this invention to present a practical mechanisms for varying the stroke of each piston in a multi-cylinder engine and in particular in V-type engine arrangements. The stroke of engine pistons can be adjusted at a very fast rate as demanded by the vehicle via sensors and an engine management system. The geometry of the link mechanism can be adjusted to allow for either, a nearly constant compression ratio at the minimum and maximum stroke positions, or different compression ratios at its two extremes to allow high compression ratio at its minimum stroke position, and low compression ratio at the maximum stroke position allowing a turbo-charger or supercharger to further enhance the power range of the engine.

These features and advantages of the invention will be more fully understood from the following description of a preferred embodiment taken together with the accompanying drawings.

In the drawings:

Figure 1 is a transverse cross sectional view of one pair of pistons arranged in a V formation with a linkage system connected to a crank assembly of a multi-piston engine, in the minimum displacement condition with one piston at the top-dead-centre position and the other piston at bottom-dead-centre position.

Figure 2 is a transverse cross sectional view of one pair of pistons as in Figure 1 but with the crankshaft rotated through 180 degrees and the engine in the minimum displacement condition.

Figure 3 is an isometric sectional view of one pair of pistons arranged in a V formation with a linkage system connected to a crank assembly of a multi-piston engine, in the maximum displacement condition with one piston at the top-dead-centre position and the other piston at bottom-dead-centre position. For clarity, the crankcase is not shown.

Figure 4 is an isometric cross sectional view of one pair of pistons as in Figure 3 but with the crankshaft rotated through 180 degrees and the engine in the maximum displacement condition. For clarity, the crankcase is not shown.

Figure 5 is an isometric view of the mechanism showing the assembled oscillating mechanism in the minimum displacement mid-stroke position.

Figure 6 is an isometric view of the control, support and adjusting shaft showing the eccentric pin that determines the stroke of the engine.

Figure 7 is a sectioned isometric and partial assembly of the adjusting shaft with the eccentric pin at its uppermost location for the minimum displacement position.

Figure 8 is a sectioned isometric and partial assembly of the adjusting shaft with the eccentric pin at its lowermost location for the maximum displacement position.

Referring to Figs. 1 and 2 of the drawings, an internal combustion engine 10 having a cylinder block 12 defining cylinder bores 14 and 15 in a "V" formation. The cylinders 14 and 15 are closed at one end by cylinder heads, which are provided with the usual inlet and exhaust port, valves, actuating gear and ignition means, none of which are shown.

Piston assembly 16 moves in bore 14 and connects to the rocking member 18 via connecting rod 20 and a pair of parallel links 22. Connecting rod 20 is pivotally connected to the piston 16 via gudgeon pin 24, and pivotally connected to the links 22 via pin 26. The other end of the links 22 is pivotally linked to the rocking member 18 by pin 28 fixed on either side of the rocking member 18. The axes of pins 24, 26 and 28 are parallel to each other. Rocking member 18 is pivotally supported at two positions on adjusting shaft 30 in a selected geometric position longitudinal along the engine block 12 and parallel to the engine crankshaft 32 and all of the pins 24, 26 and 28. Adjusting shaft 30 rotatable on bearings (not shown) within the engine block 12 webs separating the cylinder bores 14 and 15 and crankshaft 32 conventional main bearings (not shown). Adjusting shaft 30 has eccentric pin 34 rotatably connected to connecting rod 36 linked to links 22 via pin 38.

Similarly, piston assembly 17 moves in bore 15 and connects to the rocking member 18 via connecting rod 21 and a pair of parallel links 23. Connecting rod 21 is pivotally connected to the piston 17 via gudgeon pin 25, and pivotally connected to the links 23 via pin 27. The other end of the links 23 is pivotally linked to the rocking member 18 by common pin 28 fixed on either side of the rocking member 18. The axes of pins 25, 27 and 28 are parallel to each other. As shown in Figure 5, rocking member 18 straddles all the components of the oscillating mechanism and provides a strong connection to

the crankshaft 32 via pin 28 and connecting rod 40. Connecting rod 29 is rotationally connected to adjusting shaft 30 on eccentric pin 34 linking to links 23 via pin 31. The two banks of cylinders in a multi-cylinder engine represented by bores 14 and 15 are displaced from each other to allow parallel assembly of the two links 22 and 23 on a common pin 28.

The rocking member 18 connects to the crankshaft 32 via connecting rod 40, pin 28, fixed at either end to the rocking member 18, and crankpin 44. Thus the linear motion of pistons 16 and 17 is transferred to the crankshaft 32 via connecting rods 20 and 21, links 22 and 23, rocking member 18, adjusting shaft 30 with eccentric 34, and connecting rod 40.

In a preferred embodiment, adjusting shaft 30 is located at a suitable position along a vertical centerline between the two bores 14 and 15 to provide the desired variable stroke characteristics. For the minimum displacement position, the eccentric 34 of adjusting shaft 30 is rotated to the uppermost vertical position, as shown in Figure 7, . and held in position by an hydraulic or mechanical rotary actuator mounted on the crankcase 12, not shown. The selected rotary actuator needs to have an 180 degree rotary movement and controlled by an electronic engine management system using many relevant sensors, not defined.

Figure 2 represents the engine mechanism in the minimum displacement position but with the crankshaft rotated through 180 degrees. It is to be noted that regardless of the angle between the two banks of cylinders of a "V" engine, the two pistons 16 and 17 are always phased at 180 degrees from one another. Only one connecting rod 40 is required for each pair of pistons 16 and 17 and the axial offset of each pair of cylinders 14 and 15, allows the connecting rod 40 to share a common pin 28 and also to allow the crankshaft 32 to be closely coupled for a compact engine arrangement.

Figures 3 and 4 represent the engine at the maximum displacement position with each of the pistons 16 and 17 respectively at their top dead centre and bottom dead centre positions in turn, after an 180 degree rotation of the crankshaft 32. This condition is achieved by rotating the adjusting shaft 30 through an angle of 180 degrees, by the rotary actuator (not shown), to the lowermost point of its travel, as shown in Figure 8.

The stroke of the eccentric 34 of adjusting shaft 30 together with the geometries of all the linkages determine the minimum and maximum stroke of the engine and the desired compression ratio at the two extremes. However, additional adjustment of the compression ratio can be achieved by changing the rotational position of the rocking member 18 via an additional eccentric on the adjusting shaft 30.

The scope of the invention need not be limited to the mechanism shown, Variations in the positioning of the crankshaft and the rocking member and the method of altering the position of the linkages, either by hydraulic or mechanical systems, and in addition, the geometry of the linkages to achieve the same outcome, fall within this invention.

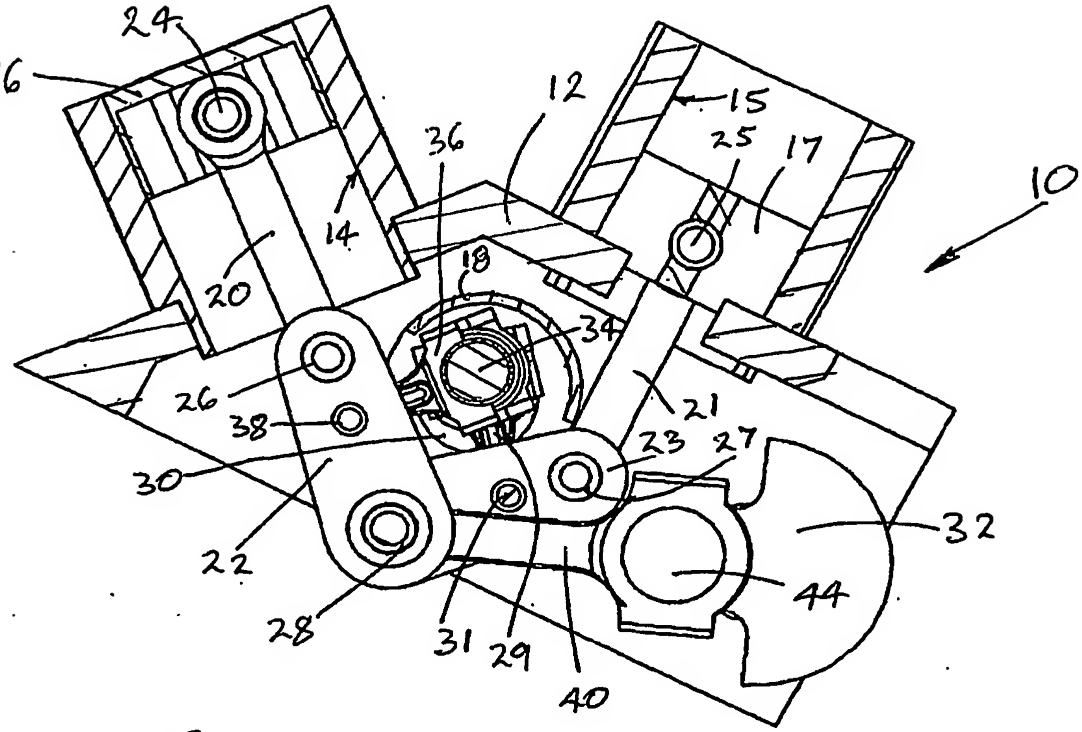

Figure 1

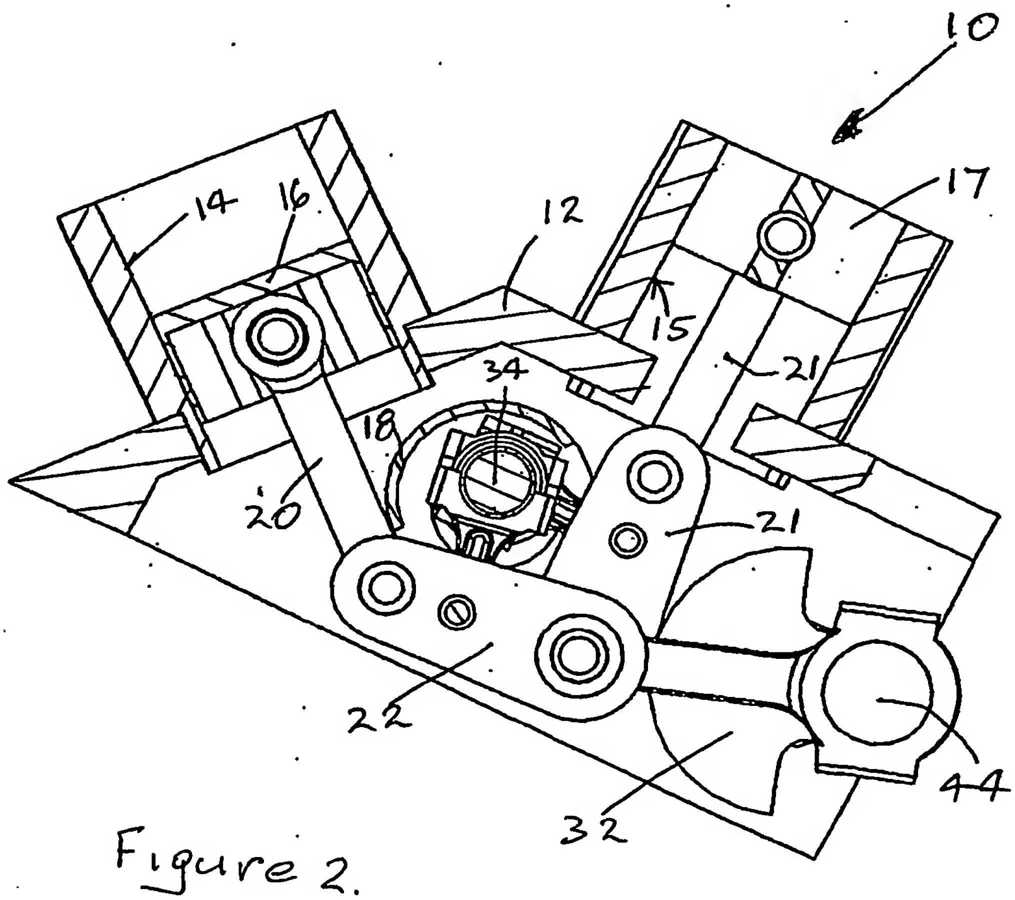

Figure 2.

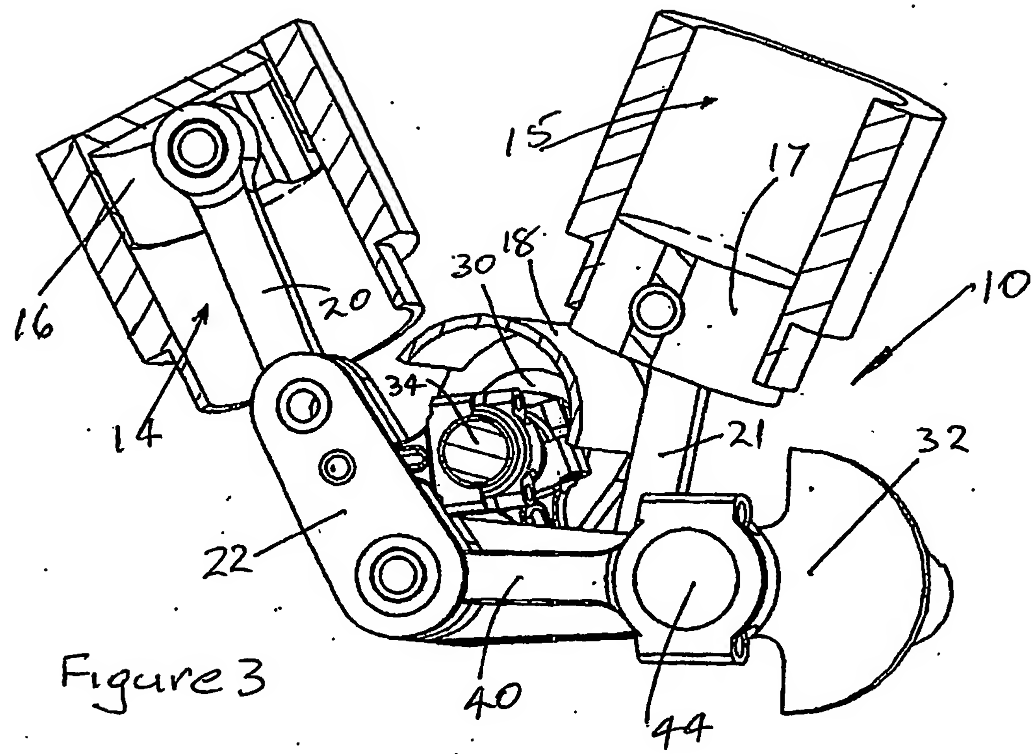

Figure 3

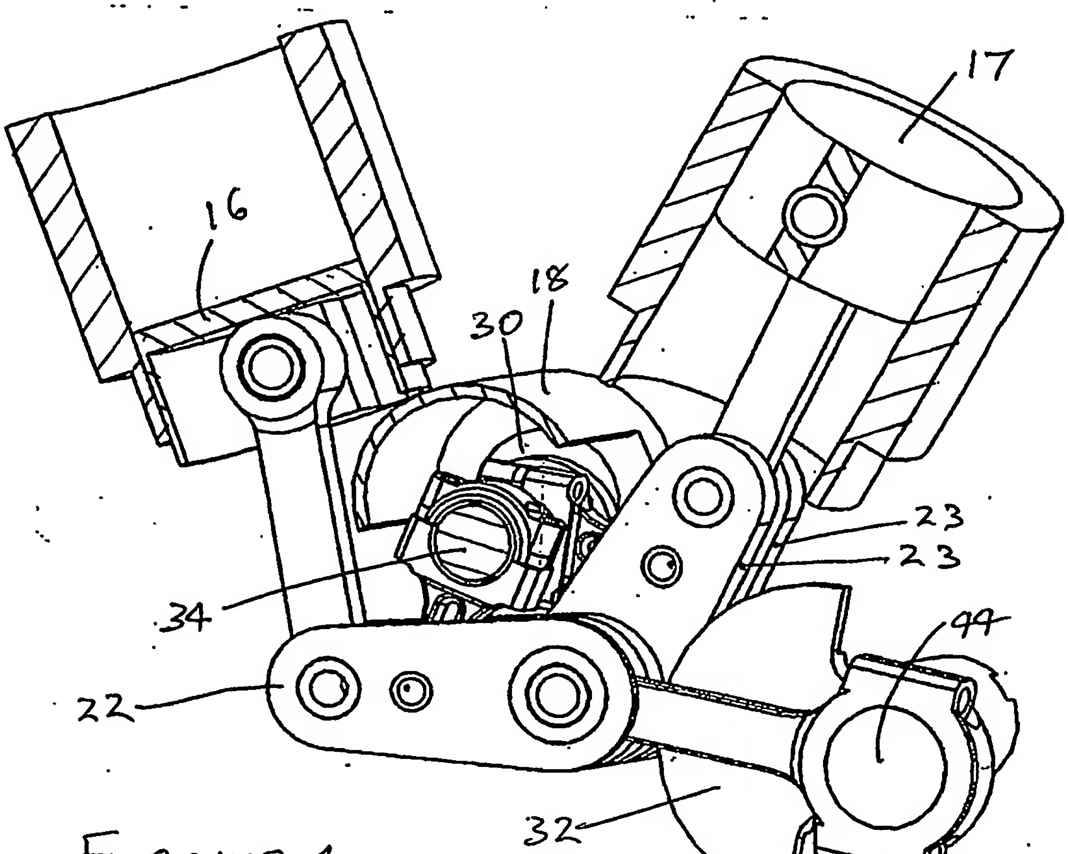

Figure 4

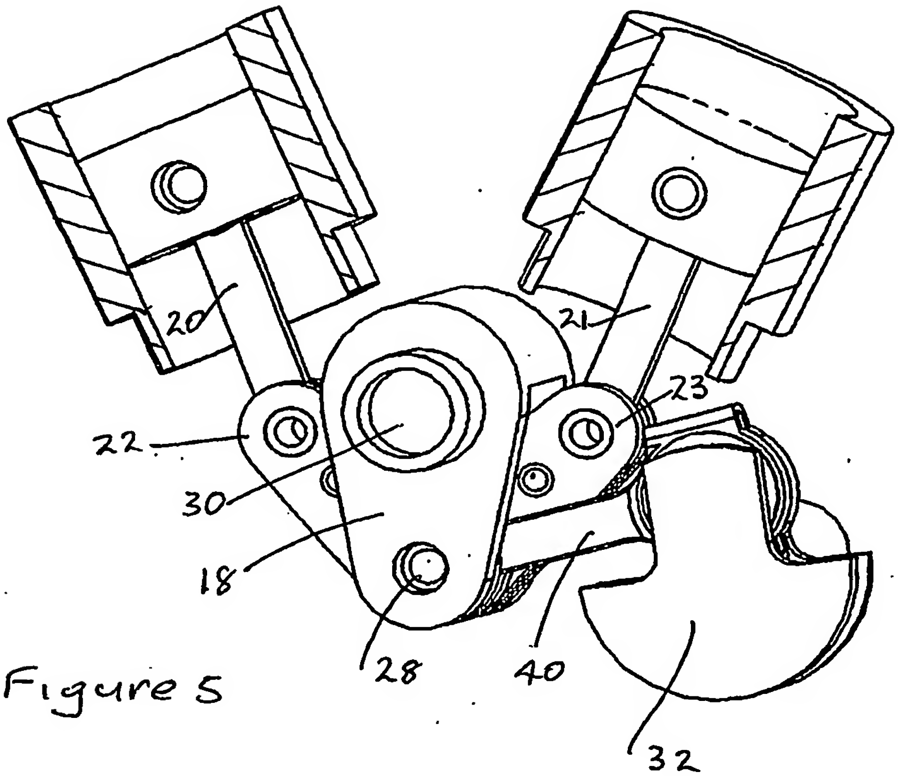

Figure 5

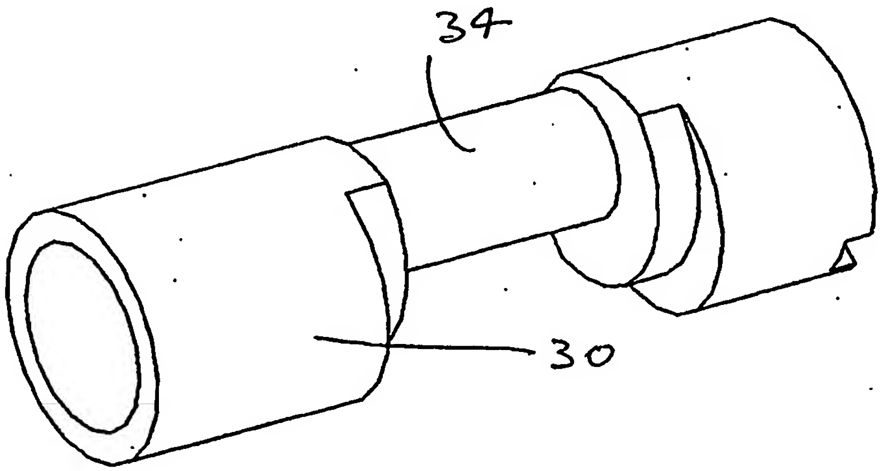

Figure 6

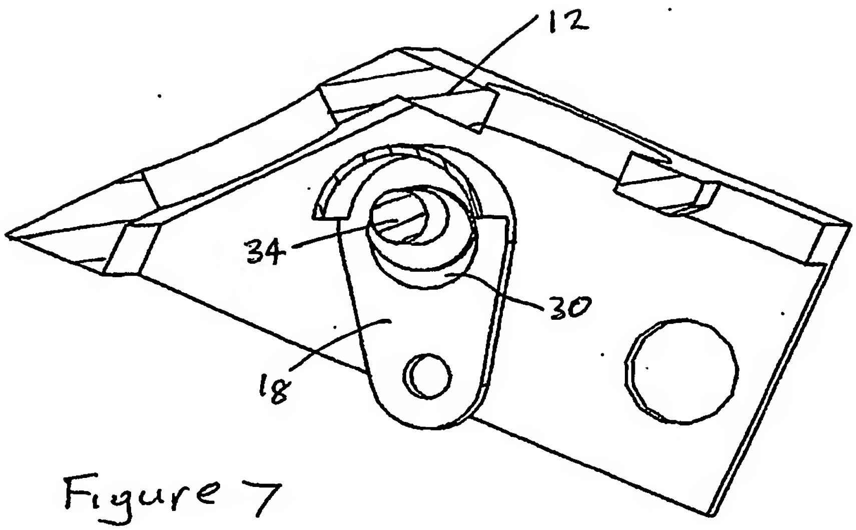

Figure 7

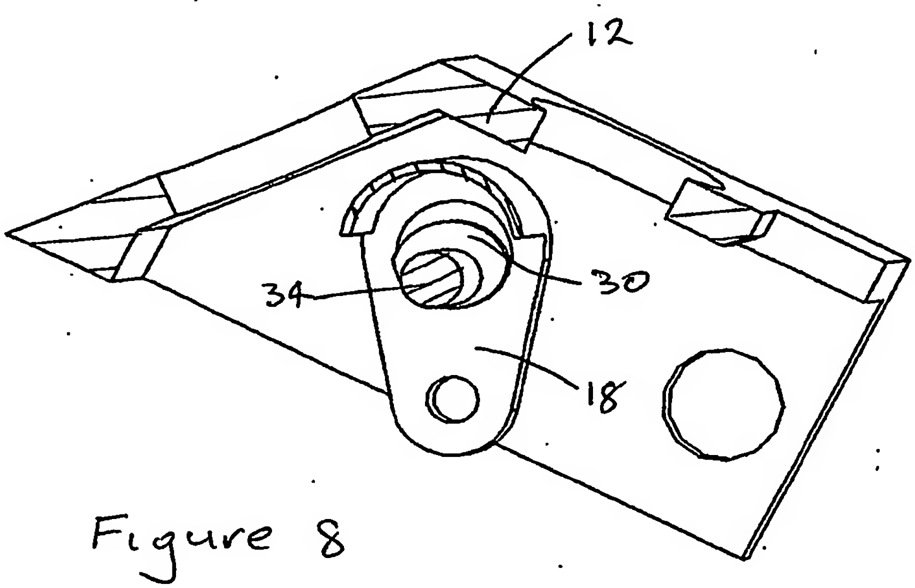

Figure 8